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Article

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The cost of making wine: A Tuscan case study based on a full cost approach[☆]

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Abstract

This article's aim is to identify and quantify the connection between a winery business typology and its production cost per bottle to create benchmarks for managerial and organisational choices. Accounting data from wineries in representative areas of the Tuscan wine sector were collected with direct, face-to-face interviews. The data were processed using a cost accounting model elaborated by UniCeSV (Centre for the Strategic Development of the Wine Sector, University of Florence) to classify costs according to production phases and production factors. The study was completed using a hierarchical cluster analysis (HCA) approach to investigate the relation between cost structures and business typologies. The implementation of the cost accounting model and the HCA showed a strong relationship between how wineries are organised and how costs are structured. Moreover, the weight of geographical localisation (i.e., belonging to a specific denomination of origin) has proved to be a key determinant in the shape of the cost structures of wineries.

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Keywords: Wine production; Full cost analysis; Clustering

1. Introduction

The wine market has undergone very important changes in recent years. Globalisation has been a key issue from geographical, logistical and consumption behaviour standpoints (Aigrain, 2003; Bernetti et al., 2006; Menghini, 2007; Scozzafava et al., 2016). In this globalised scenario, wine consumers have become more and more complex to portray because of the increasing heterogeneity of their preferences (for an extensive review, see Lockshin and Corsi, 2012). The intensification of competition and the difficulties to reach such a wide range of consumer segments have caused a reduction of profit margins, and, as a consequence, the necessity to increase

managerial skills, calling for a stronger focus on strategic aspects of management planning and activities such as cost measurement (Ciapponi, 2005; Contini et al., 2015). In fact, the estimation of the production cost of a bottle of wine is a crucial element in the management of a winery, and this cost is the basis for a correct managerial strategy and/or to check the efficiency of the various production phases (Mastroberardino, 2002; Salghetti and Ferri, 2007; Newton et al., 2015).

Nevertheless, most wine farms have not yet adopted adequate systems for the monitoring of production costs, especially those located in most of the Mediterranean countries. This situation is mainly due to structural and cultural barriers typical of sectors characterised by old production traditions, small farm sizes and family run businesses. Therefore, it is particularly relevant to fill this gap with the creation of appropriate managerial tools and to spread awareness of their pivotal role for the definition of more effective competitive strategies (Lackman et al., 2000; Xiaotao and Robert, 2013).

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The Production Cost Monitoring Centre of UniCeSV (Centre for the Strategic Development of the Wine Sector, University of Florence) has developed a specific model to be employed in cost-recording software for the wine sector. Several pilot studies (Casini et al., 2012; Alampi Sottini et al., 2013; Casini et al., 2014) have been implemented to test the effectiveness of this model. The results emphasised how this tool could also prove useful for the economic sustainability of the wineries.

This article uses the standard UniCeSV cost accounting model for the recording and analysis of production costs in the wine sector to verify how the production cost of a single bottle of wine can be an expression of business typology. If this relationship exists, such information can be used as an important benchmark for managerial and organisational choices (Ruekert et al., 1987; Liu and Leitch, 2013).

As aforementioned, the knowledge of the wine production costs could be a key element to boost the winery competitiveness and/or to check the efficiency of the various production phases. The common perception is that many wineries tend not to deepen the analysis of costs. This hypothesis is supported by the evidences found by Casini et al. (2012) studying the Chianti Classico wineries, one of the most advanced areas of the Italian wine industry.

This fact is especially true for small and medium-sized family farms, where the resources and/or the skills are not adequate to invest in improving accounting information systems, in particular in relation to cost accounting. Usually, the entrepreneur is not very keen to introduce innovative systems that go beyond general accounts (Antonelli and D'Alessio, 2007). Therefore, the absence of a management control system is a further shortcoming of several Old-World wineries if compared to global competitors, especially at a time when profit margins tend to progressively shrink (Mattiacci and Zampi, 2004; Orth et al., 2007; Gallucci and D'Amato, 2013).

The application of cost accounting in a winery requires specific expertise and resources for its successful implementation and management. Indeed, there are objective difficulties to properly assess the costs of individual bottles of wine, as the business reality is often complex and produces a wide range of wine typologies. The allocation of the share of the joint costs to a single bottle of wine is complex, and it is a key process in the context of cost management (Ciaponi, 2005). In the literature, the allocation of joint costs to a single product requires, at first, their aggregation according to one of these criteria: the individuation of homogeneous groups or “cost centres” (e.g., administration, marketing, cellar) or the activity-based cost method, which identifies the management activities that generated the costs (e.g., vineyard, vinification, ageing). Then, the aggregated costs need to be assigned to each product using appropriate partition parameters or “drivers” (Salghetti and Ferri, 2007; Nati, 1989).

Although the relevance of cost management of winemaking is high, scientific research of this topic is scant and it is mainly composed of three works. Sampedro and Sanchez (2008) proposed a computer-based model to ease the estimation of

the cost of cultivating grapes per hectare of land; however, their analysis excluded the winemaking focusing their attention on the grape-growing production phase. On the other hand, González-Gómez and Morini (2006) proposed an adapted activity-based costing system for the cost calculation of winemaking belonging to the designation of origin Tacoronte-Acentjo in Spain. Their analysis starts from the estimation of harvesting costs and ends with the estimation of bottling and labelling costs, excluding the winegrowing phase. Finally, Biondi et al. (2013) estimated the wine production cost however, they used data from a single Brunello winery making it difficult to generalize.

Starting from this literature, we intend to enhance the knowledge on cost management of the wineries applying a cost calculation model comprehensive of all tasks of the wine production i.e. from winegrowing to wine marketing. In addition, we want to provide further empirical insights in the field of wine production costs analysing data from different designations of origin to deepen the analysis of the relation between wineries' cost structure and business typology.

The article is composed of two main parts. A first one is focused on an in-depth analysis of the production costs in four denominations of origin: Chianti Classico, Brunello di Montalcino, Montegio di Massa Marittima, and Morellino di Scansano. In the second part of the article, starting from the results of the previous analysis, a cluster analysis is performed in order to identify specific business profiles according to cost structure and the winery groups resulting from the analysis are described. If the first part has mainly a descriptive value and, in a broad sense, is more directly practical, the second is more relevant from an analytic perspective, offering results that go beyond the survey of the structure of production costs in the different denominations of origin included in the analysis.

Data on winemaking costs were gathered with a face-to-face survey carried out on 76 wineries in the selected areas belonging to the four denominations of origin. The survey included questions related to the production costs of winemaking and the structural characteristics of the wineries, such as the quantification of their output and the size of the winegrowing areas.

2. Case study and methods

According to the 6th Agricultural Census by the Italian National Institute of Statistics (ISTAT, 2010), Tuscany is one of the most important wine regions in Italy in terms of utilised agricultural area (UAA). A total of 25,920 farms cultivate 59,838.88 ha (ha) (almost 14% of the national total) of vine; denomination of origin (DO) areas account for 68.45% of the regional total and 32.34% of the farms. The areas dedicated to grape growing are mostly concentrated (Fig. 1) in the provinces of Siena (30.6%), Florence (30.7%), and Grosseto (12.4%). More than 2,200,000 hL of wine were produced in the region in 2013, with DO wine representing 67% of the total.

The regional wine sector is characterised by two larger denominations of guaranteed control (DOCGs), Chianti and Chianti Classico, which represent, respectively, 49.7% and

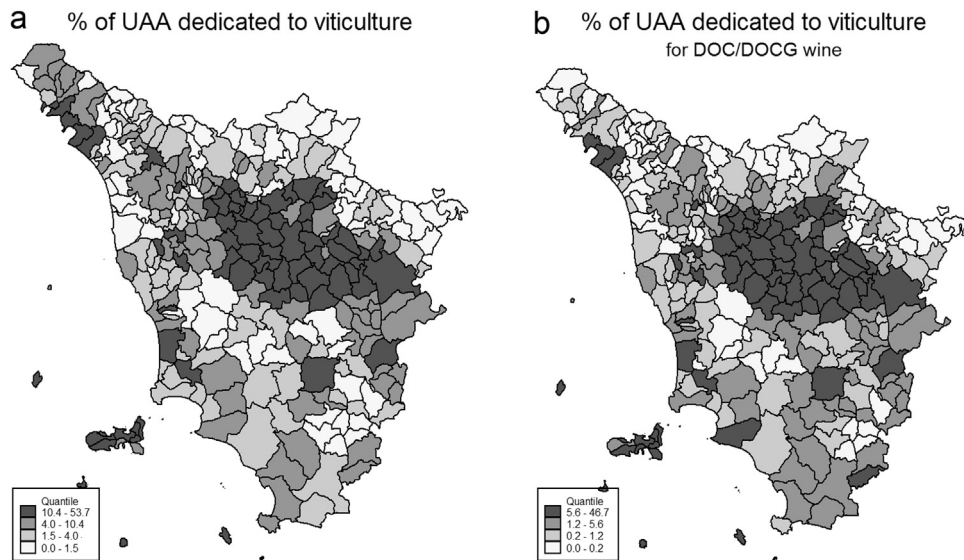


Fig. 1. Tuscan municipalities specialising in viticulture.
Source: Sixth Italian Agricultural Census (2010).

16.4% of all the DO wine produced in Tuscany, followed by Brunello di Montalcino (5.8%), Morellino di Scansano (5.1%), Nobile di Montepulciano (3.9%), Bolgheri (2.7%), and Vernaccia di San Gimignano (2.5%); other DO productions account for less than 1.5% each. Finally, IGT (or “geographical indication”) wines represent 32% of the regional production. DOs are a key factor in the analysis of farm typologies. It is possible to roughly identify two groups: one that mainly produces DO wines, with an average vineyard area of 7 ha per farm and producing 5000 bottles per hectare, and one that produces mainly table wines, with an average vineyard area of less than 1 ha and producing almost 7000 bottles per hectare (Regione Toscana, 2013).

The traditional weight of denominations and the development of their role in the Tuscan wine sector are the main reasons why this study was focused on DO-producing wineries, concentrating the attention towards “historical” DOs—Chianti Classico and Brunello di Montalcino—and “new” DOs—Monteregio di Massa Marittima and Morellino di Scansano—located on internal and coastal hills, in an attempt to cover the wider quality range of regional wine production. Within the four chosen DOs, the wineries to be included in the survey were identified with a random extraction on a stratified sampling based on vineyard area. The survey was conducted on 40 wineries from Chianti Classico, 19 from Brunello di Montalcino, 9 from Morellino di Scansano and 8 from Monteregio di Massa Marittima, for a total of 76 interviews.

A specifically designed questionnaire was administered to each winery via direct, face-to-face interview, allowing for the identification of the production cost of the main product of each winery in quantitative terms. Table 1 shows some descriptive statistics of the wineries included in the sample.

The total cost was classified according to production phases (grape production, vinification, ageing, bottling and marketing), and for each of them, the costs for every production

factor were determined (Table 2). The analysis resulted in the definition of “standard” costs for each DO.

The evaluation of the production cost of a bottle of wine was performed using the full-cost method (Ghelfi, 2000; Torquati, 2003; Antonelli and D’Alessio, 2007). The applied method is based on a general premise: the winery is characterised by diverse phases of production distinguished by the fact that each of them has an input from the previous production stage and from outside the farm, as well as an output for the next stage or, directly, the market. For this reason, the model can be applied to any farm, irrespective of their level of integration in the production process, according to the technical and economic characteristics of the production chain. Accordingly, the winemaking is split into four phases (Fig. 2):

- Phase 0: Production (from the vineyard to the grape)
- Phase 1: Processing I (from the grape to the fermented wine)
- Phase 2: Processing II (from the fermented wine to the aged wine)
 - Sub-phase: Aging wine in wood
 - Sub-phase: Bottling
 - Sub-phase: Aging wine in bottle
- Phase 3: Marketing (selling activities).

For each of these phases (and sub-phases) a production cost is estimated. Moreover, as the process is articulated over several years, the applied model has a multi-period implementation; therefore, if a phase lasts longer than a single financial year (e.g., the ageing phase), the model keeps track of the produced value and the relative costs for every single year.

The production cost considers the remuneration of all the factors that contribute to the making of a bottle of wine, including both the explicit and implicit costs. The former also accounts for such items as the inputs that the owner’s family provide in a family-run business (i.e., family labour, land opportunity cost).

Table 1
Descriptive statistics.

Denomination	Statistics	Total agricultural land (Ha)	Total vineyard surface area (Ha)	Total production (HL)	Of which DO Production (HL)	Workforce**	Family workforce	Non-family workforce
Chianti Classico	Mean	198.63	35.47	2610.33	1.423.13	15.21	1.20	14.01
	Median	105	26.21	987.50	825	8	1	7
	St. Dev.*	248.46	37.77	8858.37	2.421.63	30.02	1.33	30.29
Brunello di Montalcino	Mean	187.78	28.12	1233.29	991.62	16.11	1.53	14.58
	Median	53	21.32	892	590	10	2	9
	St. Dev.	359.38	31.11	1397.32	1113.91	21.94	0.98	22.49
Morellino di Scansano	Mean	223.78	31.38	1944.89	1.288.89	14.56	0.56	14
	Median	97	26	1560	800	13	0	13
	St. Dev.	242.18	16.62	1684.79	1.211.95	4.42	0.88	4.53
Monteregio di Massa Marittima	Mean	46.60	8.82	434.85	275.63	5.81	1.19	4.63
	Median	38	10.20	446.41	212.50	4.50	1.25	3
	St. Dev.	28.20	3.78	170.71	204.18	5.97	0.96	6.65
Whole sample	Mean	170.64	28.22	1802.92	971.92	13.50	1.24	12.26
	Median	74	20.19	896	200	23.44	1.16	23.74
	St. Dev.	257.68	31.86	6193.69	4.566.21	15.21	1.20	14.01

Note: *St. Dev. is standard deviation. ** Part-time workers weight for one-half.

Table 2
Production factor cost items and their descriptions.

Item	Description
Family labour	Labour cost for members of the owner's family
Non-family labour	Labour cost for employees
General costs	Rents, administration, energy, insurance, consulting, training, financial costs, maintenance
Depreciation	For buildings, agricultural machinery, cars, trucks, vinification and bottling equipment, tanks, barrels, vineyard planting
Variable costs	Pest management, fertilisers, vineyard equipment and tools, subcontracting, fuels, commercial and distribution costs, packaging, DO certification
Land opportunity cost	Calculated as an annual interest on the value of land, net of vineyard planting cost

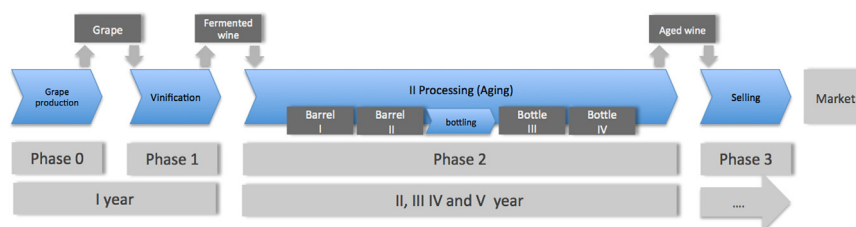


Fig. 2. Wine production process.
Source: Alampi Sottini et al. (2013)

The applied model considers that the winemaking production phases are considerably differentiated and in each of them it is possible to have the product of the previous phase or one acquired externally as inputs. Moreover, the output of each phase can be the input of the subsequent phase or, alternatively, sold it on the market (Alampi Sottini et al., 2013). More specifically, in the Phase 0, the model accounts for the units of planted vines and the respective grape varieties and all of the

inputs linked with agricultural activity considering the grapes as outputs. For Phase 1, the system distinguishes the grape varieties and associates them with the corresponding processed wines. For Phase 2, the model identifies the aged wines produced, linking them with the respective processed wines from which they originated. Finally, in Phase 3, the link between the final product and the source mix is defined. Therefore, the system allows the product “traceability” as the

model is able to go back, for each label, to the original grapes and vineyards.

In conclusion from the vineyard to the bottle, the proposed model estimates, for subsequent phases, the costs of grapes, vinified wine, aged wine, and the bottle for each label. Thanks to these results winery can draft budget plans and final economic balance able to support the business's strategic decisions. Moreover, determining relative costs and revenues of the single activities of the winery it is possible to calculate the value generated by each activity and estimate their relative contribution to the winery's business performance.

The estimation of the total cost of the bottle of wine was performed using a specific software developed by the Uni-CeSV research group (Casini et al., 2014, Alampi Sottini et al., 2013). Indeed, the described model was incorporated into a software that begins with a usual input area (IA) and ends with an output area (OA). The input area is constituted by a farm info system (FIS) and a drivers set (DS), which then transfer the collected data into an analysis area (AA), which is divided in two linked databases, AA1 and AA2. AA1 includes the input data from the production process, divided into phases, and the relative costs for calculating the production cost of each phase and each product. The output of the AA1 database is then used and elaborated on by AA2 by applying the drivers set to the indirect costs (Fig. 3). The data collected during the interviews were uploaded in the software, with the possibility of using as input the total costs for each production factor.

The software uses the same factor classification for the attribution of cost shares to the single bottle of wine. Moreover, the software's output can identify the costs for each phase (grape production, vinification, ageing, bottling and selling) or classify costs as *explicit* (all cash expenses—the sum of

general, variable, and non-family labour costs) and *implicit* (depreciation, family labour and land opportunity cost).

As aforementioned, the procedure calculated, for the most representative wines of each winery, the production cost per bottle and the separate items for each production factor and for each production phase. Moreover, the level of detail of the data allowed us to implement further elaborations to verify how much production costs are influenced by different business typologies and by the location within different DO territories.

To identify the wineries with distinctive characteristics, a cluster analysis (CA) was performed. The CA is a set of techniques of multivariate statistical analysis with the main purpose of grouping (classifying) a set of observations as a function of the characteristics they possess. In this way, it is possible to identify groups of statistical units, as homogeneous as possible within them and differentiated between them, with respect to a set of variables (Delvecchio, 1992; Molteni, 1993; Hair et al., 2006; Vercellis, 2006).

The CA was applied to the previously described sample of wineries with a hierarchical procedure using the Ward method. This procedure provides that from a starting situation, where each observation of the sample is assigned to a separate cluster, a single set is identified through the subsequent steps in which the various clusters that are most similar to each other are aggregated one by one. The degree of similarity is measured through a “proximity” indicator among the various clusters that are formed in the various steps, where smaller distances represent greater similarity between the groups. The analysis of these indicators helps to determine the number of groups for which it is relevant to conduct subsequent analyses.

It must be pointed out that the CA was performed excluding the wineries that, within their production process, acquire grapes, grape must, or aged wine for the denominations observed in this study. Therefore, only the wineries covering all phases of the production process were considered to avoid biases on the cluster results (variables with a 0 value in certain production stages).

3. Results

The data were analysed in three subsequent steps: the first two resulted in the definition of the composition of costs according to production factors and phases for each denomination (Tables 3–5), and the last one consisted of the implementation of the Cluster Analysis.

3.1. Production factors analysis

The average production cost of a bottle of *Brunello di Montalcino DOCG* is 9.49€, with a minimum of 6.19€ and a maximum of 14.99€. Average explicit costs are 5.34€/bottle, and implicit costs are 4.15€/bottle. The median (9.28€/bottle) and the standard deviation (2.58€/bottle) show that the sample is characterised by a rather relevant dispersion around the mean. Variable costs (27%) is the most significant item, followed by depreciation (22%) and non-family labour costs (16%), whereas general costs (12%) and family labour (9%)

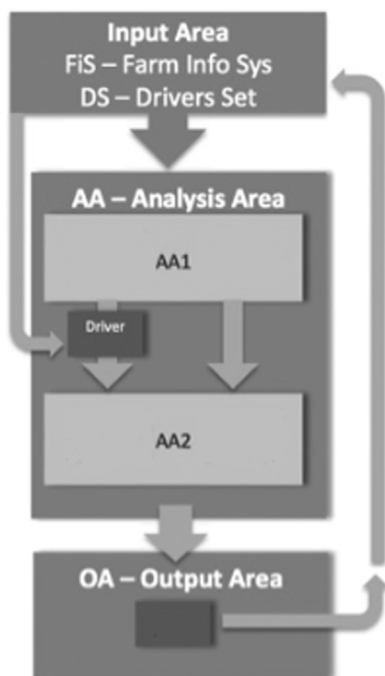


Fig. 3. Scheme of the Cost-Accounting Process.
Source: Alampi Sottini et al. (2013).

Table 3

Composition of Total Cost per production factor (%) for each denomination.

Denomination	Family Labour	Non-Family Labour	General Costs	Depreciation	Land Opportunity Cost	Variable Costs	TOTAL	IMPLICIT	EXPLICIT
Brunello di Montalcino	9	16	12	22	13	27	100	44	56
Morellino di Scansano	2	29	16	17	1	35	100	20	80
Monteregio di Massa Marittima	8	19	13	20	1	39	100	29	71
Chianti Classico	9	20	12	20	6	32	100	35	65

Table 4

Total cost for each denomination (€/bottle): descriptive statistics.

Denomination	Median	Mean	St. Dev.	Min	Max
Brunello di Montalcino	9.28	9.49	2.58	6.19	14.99
Morellino di Scansano	3.38	3.38	0.75	2.4	4.81
Monteregio di Massa Marittima	4.75	4.85	1.64	2.73	8.05
Chianti Classico	4.47	4.93	1.27	3.66	9.62

represent less relevant parts of the total cost. Land opportunity cost is 13% of the total production cost, which shows that the Montalcino territory is a region highly valued for its grape production. As for general costs, the main cost items concern “consulting” (28%), “energy” (16%), “rents” and “administration costs” (13%), followed by “financial costs” (12%) and “ordinary maintenance” (9%). “Packaging” is the main item among variable costs (43% of total variable costs) followed by “marketing” (31%). The relevance of packaging and marketing aspects in the composition of the total cost underlines the market-driven nature of the Montalcino wine business. The structure of depreciation is more complex, given the many cost elements. The largest item includes “buildings” (22%) and “vineyard planting” (20%), followed by “wooden barrels” (20%) and “tuns” (9%).

The mean and median value of the production cost of a bottle of *Morellino di Scansano DOCG* is 3.38€, with a minimum of 2.40€ and a maximum of 4.81€. The low standard deviation (0.75€) shows that in our Morellino sub-sample, the results are homogeneous and cost dispersion from the mean value is modest. Average explicit costs are 2.71€/bottle, and implicit costs are 0.76€/bottle.

The analysis per production factors shows that variable costs are the larger cost item (35%), followed by non-family labour costs (29%), depreciation (17%), and general costs (16%). Family labour and land opportunity costs are 2% and 1% of the total production cost, respectively. Within general costs, the main items are “rents” (37%), “consulting” (19%), “energy” (15%), “ordinary maintenance” (10%) and “financial costs” (8%). Among variable costs, on the other hand, “packaging” is the most relevant part of the total, with a share of almost 50%, with “marketing” (22%), “pest management, fertilizers, vineyard equipment” (8%) and subcontracting (6%) as the other main items. Moreover, “buildings” play the larger role in the depreciation costs structure (38% of the total), followed

by “vineyard planting” (18%), and “agricultural machinery” (10%).

The average cost for a bottle of *Monteregio di Massa Marittima DOC* is 4.85€, varying between 2.73€ and 8.05€, with a median value of 4.75€. The low standard deviation (1.64) highlights homogeneous results for the selected sample and a low dispersion of costs from the mean value. Average explicit and implicit costs are 3.44€/bottle and 1.41€/bottle, respectively. The analysis of the costs from a production factor perspective shows that variable costs represent the larger item (39%), followed by depreciation (20%) and non-family labour (19%). General costs (13%) and family labour (8%) have a minor impact, with land opportunity cost accounting for only 1% of the total. The main items within general costs are “consulting” (31%), “rents” (19%), and “ordinary maintenance” (12%), followed by “energy” (11%), “financial” (11%), and “administration costs” (10%). The main item among variable costs is “packaging” (45%), followed by “commercial and distribution” (19%), “subcontracting” (16%), “pest management, fertilisation and vineyard management equipment” (9%) and “fuels” (7%). The composition of the depreciation share is more complex given the numerosity of cost elements. “Vineyard planting” is the main element, representing 26% of the total; the second one is the depreciation of the “wooden barrels” (19); “buildings” and “agricultural machineries” represent 17% and 11%, respectively.

The average cost of production of a bottle of *Chianti Classico DOCG* is 4.93€, with a minimum value of 3.66€ and a maximum of 9.62€. The average explicit costs are 5.34€, whereas the implicit costs are 4.15€. The observed standard deviation, 1.27€, is relatively high, showing that the examined sample is characterised by a significant dispersion from the average value of the costs. Variable costs (32%) account for the largest proportion, followed by depreciation (20%) and non-family labour cost (20%). General costs (12%) and family labour (9%) are lower proportions of the total. The land opportunity cost absorbs 6% of the production cost, demonstrating the high propensity to viticulture of the areas of interest by the production of *Chianti Classico*. The main costs comprising the general costs are “consulting” (27%), “rents” (16%), “financial costs” (15%), “routine maintenance” (15%), “energy costs” (12%), “insurance” (8%), and “administrative costs” (8%). Regarding the variable costs, the main cost is “packaging,” which absorbs 49% of the total, followed by “commercial and distribution costs” (16%) and by “sub-

Table 5

Composition of Total Cost per production phase (%) for each denomination.

Denomination	Grape production	Vinification	Ageing	Bottling and marketing	Total cost
Brunello di Montalcino	41	10	14	35	100
Morellino di Scansano	27	17	10	46	100
Montegio di Massa Marittima	30	12	10	48	100
Chianti Classico	34	10	12	43	100

contracting” (16%). Several cost items comprised the amortisations. The biggest expense is “vineyard planting” (34%), followed by “small wooden barrels” (19%), “buildings” (16%), and “large wooden barrels” (8%).

3.2. Production phase analysis

Analysing the stages dedicated to the wine production process, the agronomic phase of grape production accounts for the major portion of the total costs. In the case of the Brunello di Montalcino appellation, it amounts to 3.89€, and represents 41% of the total cost. The cost of bottling and marketing (3.30€) is significant, at 35%. Vinification (0.93€, 10% of the total cost) and ageing (1.37€, 14% of the total cost) are phases with less of an effect on the final cost of a bottle of *Brunello di Montalcino*. The increasing incidence of costs related to grape production is due to the lower yield of grapes per hectare, which is defined by the production standard of the geographical appellation. The cost of ageing is due to the use of large and small wooden barrels and to the particularly long duration imposed by, again, the production standard of the geographical appellation. For grape production, higher costs are land opportunity cost (32%), non-family labour (22%) and depreciations (18%), whereas the vinification stage sees a prevalence of depreciations (37%) and general costs (29%). The costs for the ageing of wine are absorbed for the most part by the amortisations (57%), of which the 53% depend on the small wooden barrels, 23% from large wooden barrels, and by the general costs (22%). Finally, the bottling and marketing are affected more by the variable costs (64%), which are mostly packaging (52%), and commercial and distribution costs (38%).

Regarding the Morellino di Scansano appellation, the cost of bottling and marketing, 1.55€, represents 46% of the total cost, followed by the cost of grape production (0.92€), equal to 27% of the total cost. The vinification costs (0.56€) and ageing (0.35€) absorb 17% and 10%, respectively. Concerning the grape production, the costs with the greatest impact are non-family labour costs (42%) and the amortizations and general costs, both 19%. The vinification phase has a prevalence of non-family labour cost (37%), followed by general costs (26%) and depreciations (25%). The costs for the ageing of wine are absorbed for the most part by the amortizations (39%), of which the 53% are dependent on the buildings and 38% from small wooden barrels, non-family labour costs (29%), and general costs (29%). Finally, the bottling and marketing are affected more by the variable costs (64%), which are primarily

composed of the packaging (61%), and commercial and distribution costs (26%).

For the wine produced under the *Montegio di Massa Marittima* appellation, the cost of bottling and marketing is 2.33€, which is 48%, nearly half of the total cost; next highest is the cost of grape production (1.45€), equal to 30%. Vinification costs (0.58€) and ageing (0.50€), respectively, absorb 12% and 10% of the total cost. For grape production, the costs with the greatest impact are represented by the variable costs (30%), the amortisations (28%) and non-family labour costs (22%). The vinification phase also includes depreciations (34%) and general costs (26%). The costs for the ageing of wine are primarily composed of the amortisations (50%), of which the 74% depend on the amortisations of small wood barrels, and by the general costs (27%). Finally, the bottling and marketing make up a large portion (59%), mostly comprised of the packaging (61%) commercial and distribution costs (26%).

Even for the *Chianti Classico* appellation, the cost of bottling and marketing are relevant, with 2.13€ representing 43% of the total cost, followed by the cost of grape production (1.68€), equivalent to 34%. The ageing costs (0.61€) and vinification (0.50 €), respectively, absorb 12% and 10%. The costs that count most in the grape production phase are represented by non-family labour costs (32%), the amortizations (24%) and the land opportunity cost (16%), whereas the vinification phase sees a prevalence of general costs (29%), depreciation (27%), and non-family labour cost (27%). The costs for the ageing of wine are absorbed for the most part by the amortizations (52%), which depend 57% on the small wooden barrels, 25% on the large wooden barrels, and 24% on general costs. The phases of bottling and marketing are affected more by the variable costs (60%), which are affected by the packaging costs (61%), and, to a lesser extent, by the commercial and distribution costs (19%).

The comparative analysis of the production costs of the different appellations suggests a link between different territories and specific cost items, the most evident clue being the impact of land opportunity cost on the composition of the final production cost. The composition of costs in the production phase, moreover, highlights a certain heterogeneity in the impact of the grape production stage on the final cost, with higher reputation territories associated with a higher impact of this specific stage. It is also possible to hypothesise a compensatory effect between the territory reputation and marketing costs, with powerful collective territorial brands

abating marketing transaction costs and easing the channelling of the product to the market.

All these clues and hypotheses led us to believe that a further analysis was required to search for sounder evidence. The hierarchical cluster analysis (HCA) described in the following paragraph was performed with the objective of testing the existence of homogeneous groups of farms (with specific cost structures) for different territories and wine reputations.

3.3. Hierarchical cluster analysis

Two HCAs were performed using two sets of variables representing the main classifications of production costs resulting from the cost accounting model used for the collection and the analysis of data:

- Set 1: production phase costs (all items pertaining to grape production, vinification, ageing, bottling and marketing)
- Set 2: production factor costs (all items pertaining to the labour, capital and land categories).

The choice of the hierarchical level was based on the observation of dendrograms and the dissimilarity measure, resulting in a two-level cut for Set 1 and a four level cut for Set 2.

Table 6 shows the main characteristics of the groups resulting from the Set 1 HCA.

The HCA results show significant differences between the two groups of wineries in relation to both average production cost and its composition. In terms of production phases, the costs of the first three (grape production, vinification and ageing) for the second group are more than double those of the first. In terms of production factors, the second group shows higher values in all the categories, especially for common costs, depreciation, and non-family labour. The results for labour costs are probably because the two groups of wineries differ in the skill level of human capital they require. On the other hand, the two groups are very similar in terms of average vineyard areas and DO grape cultivation. However, the data show that the second group has a lower yield per hectare and a higher share of DO wine production in their portfolio, indicating a stronger attitude toward high quality. It is also

Table 6
Results of Set 1 HCA (production phase costs).

Characteristics	Group 1	Group 2
	<i>"Standard Quality"</i>	<i>"Top Quality"</i>
n. of wineries	47	24
cost per bottle (€)	4.45	9.11
Labour	Mainly family	Mainly non-family
vineyard area (ha)	30.13	31.86
DO vineyard area (ha)	21.54	20.03
bottled wine (%)	78.79	86.16
DO	Chianti Classico, Monteregio, Morellino	Brunello, Chianti Classico

important to point out how belonging to a specific territory seems to be a relevant factor in the group's composition, as the first group is mainly composed of farms belonging to lower quality DO. Territories and all the farms from the Montalcino area are concentrated in the second one. Chianti Classico farms, which represent a wider range of business typologies and produce wines belonging to several quality segments, are split between the two groups. The emphasis on quality aspects in the characteristics of the groups explains our use of "standard quality" and "top quality" for their definition.

Table 7 shows the main characteristics of the groups resulting from the Set 2 HCA.

The results of this second HCA confirm what emerged from the first one, and add additional insights. Specifically, the second HCA basically splits the groups resulting from the first one into more defined groups. With only a few exceptions the wineries belong the group 1 from the first HCA splits into groups 1 and 2 from the second HCA; the wineries belong the group 2 from the first HCA splits into groups 3 and 4 from the second HCA. The word "brand" was used in the definition of the four resulting groups for two main reasons: the strong characterisation of the first group as a bulk wine selling category, with no emphasis on branding, and the business/territory diversification that suggests different brand strengths that depend on the identity of both the winery and its DO.

The four groups differ significantly in terms of average cost per bottle and its composition, showing a progressive increase in the quality of the product and specific characteristics related to business organisation, management, and territory. This representation allows for a better description of specific benchmarks in relation to different production environments and settings: for example, the different composition of production costs shows how the wineries belonging to the first two groups, even though they share a similar average cost per bottle, differ in terms of business structure, especially in relation to size and labour market.

Table 7
Results of Set 2 HCA (production factor costs).

Characteristics	Group 1	Group 2	Group 3	Group 4
	<i>"No Brand"</i>	<i>"Average Brand"</i>	<i>"Top Brand"</i>	<i>"Elite"</i>
n. of wineries	20	22	20	9
cost per bottle (€)	4.39	4.20	7.33	11.21
Labour	mainly family	mainly non-family	mainly non-family	family & non-family
vineyard area (ha)	20.64	39.62	37.12	17.13
DO vineyard area (ha)	13.05	30.22	23.51	10.76
bottled wine (%)	24.33	92.50	81.65	91.89
DO	Chianti Classico, Monteregio	Chianti Classico, Morellino	Brunello, Chianti Classico, Monteregio	Brunello

Table 8
Composition of average costs for Set 2 HCA (€/bottle).

Macro cost items	Group 1	Group 2	Group 3	Group 4	Total
	"No Brand"	"Average Brand"	"Top Brand"	"Elite"	
<i>Factors</i>					
Family labour	0.89	0.13	0.14	1.51	0.52
Non-family labour	0.35	1.15	1.98	1.23	1.17
Common costs	0.31	0.58	1.12	1.17	0.73
Depreciation	0.97	0.81	1.32	2.78	1.25
Variable costs	1.65	1.32	2.13	3.05	1.86
<i>Av. Total Cost</i>	<i>4.39</i>	<i>4.20</i>	<i>7.33</i>	<i>11.21</i>	<i>6.03</i>
<i>Phases</i>					
Grape production	1.34	1.46	2.68	4.82	2.19
Vinification	0.38	0.49	0.81	1.12	0.63
Ageing	0.56	0.51	0.92	1.57	0.77
Bottling - Marketing	2.11	1.74	2.93	3.71	2.43
<i>Av. Total Cost</i>	<i>4.39</i>	<i>4.20</i>	<i>7.33</i>	<i>11.21</i>	<i>6.03</i>

The average cost per bottle of group 4 is over 50% higher than that of group 3. In addition, group 4 represents a typology of smaller, more family-run and quality-oriented wineries with a strong territorial brand, whereas group 3 includes larger, more complex organisations producing high-quality wines and belonging to different territories, indicating a strength based on diverse combinations of business and territorial brands.

As a final remark, the description of the results indicates that the territorial aspect, although not the main focus of the study at the beginning, was found to have a pervasive influence on the cost structures of wineries. Thus, the territorial reputation linked to specific DOs goes far beyond being a contextual issue, as a specific localisation determines the quality of the final product, crucially impacting the composition of factor and phase costs.

Table 8 shows the composition of average costs per bottle for the four groups resulting from the second HCA. The groups are differentiated according to average production cost. This fact enhances the idea that a relationship occurs between being located in a specific production area, which represents a specific level and range in terms of quality, and production costs. Indeed, focusing the attention on the Chianti Classico wineries, which produce a wide quality range of products, it can be noted that they belong to the first three groups identified by HCA. At the same time, Brunello wineries, with a narrow quality range, are the only DO in the top-quality level group that we have called 'Elite'. Therefore, producing in a specific area may influence the winery's cost structure expanding or limiting managerial choices in terms of final product quality level and sale prices.

4. Managerial implications and conclusion

This study has tested the validity of the UniCeSV full cost accounting model as a useful tool in support of decision-making processes for wineries, highlighting its importance when applied on a territorial level.

The results of the study clearly show that the information on the distribution of total costs among phases and production factors can certainly provide indications to improve business management. The most important result is represented by the elicitation of an unequivocal relationship between different cost structures and different, well-defined business typologies. In more detail, the HCAs highlight an articulated link between the cost of a single bottle of wine and the level of wine quality, the managerial and organisational structure of the winery, and the prestige of the territorial brand. This link justifies the possible use of the results for the definition of benchmarks to guide management choices and decisions. In particular, the deviation from defined benchmarks/standard costs could represent an impulse for winery managements to perform specific market analyses to verify the economic feasibility of their activities; moreover, if such deviations are traceable to specific cost items, they may be interpreted as a signal to be investigated to identify and correct the problem. In addition, at the local level, the information and the economic-financial data supplied by the study can be a useful tool for the preparation of business plans and feasibility analyses for potential new activities and investors. The results obtained with this model would be of further significance if matched with results on studies of prices and mark-ups; this would provide valuable information to better understand if and how different business decisions and marketing strategies need to be implemented to improve profit margins.

The benefits deriving from the application of this model can also be expanded by extending the observations and data recording to more differentiated territories that include other DOs and by setting a dynamic, systematic monitoring of the data. In fact, only a timely and continued recording of production costs can provide useful and reliable information. To do so, it is imperative to increase the interest of farmers towards management control tools for the creation of local monitoring centres.

Conflict of Interest

The authors declare no conflict of interest

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